3) The Examiner's attention is directed to applicants' Second Information Disclosure Statement that was filed on November 4, 2002, and "crossed in the mail" with the Office Action. Please consider the cited reference AC, and return an initialed, signed and dated acknowledgment copy of the Form PTO-1449 of November 4, 2002, together with the next official communication.

4) The specification has been editorially amended to correct a few minor typographical and grammatical errors. The amendments do not introduce any new matter. A marked-up version of the amended portions of the specification is enclosed. Entry of the amendments is respectfully requested.

5) Independent claim 1 has been amended to more clearly recite that the coating layer consists of nickel-tungsten alloy, and to incorporate the subject matter of claims 2 and 3. Accordingly, claims 2 and 3 have been cancelled. Dependent claims 5 and 7 have been amended in an editorial manner for consistency of terminology. The present amendments do not introduce any new matter. A Marked-Up Version of the amended claims is enclosed. New claims 9 to 11 have been added. Claim 9 depends from claim 1 and is based on subject matter supported in the specification in Table 1 on page 8 and Table 2 on page 9. Claim 10 is an independent claim based on the subject matter of original claims 1, 2 and 3, written with slightly different claim terminology, format and style. Claim 11 depends from claim 10 and is based on subject matter supported in the original specification in

Table 1 on page 8 and Table 2, page 9. Thus, the new claims do not introduce any new matter. Entry and consideration of the claim amendments and the new claims are respectfully requested.

6) Referring to section 2 on pages 2 to 3 of the Office Action, the rejection of claims 1 and 5 to 8 as anticipated by U. S. Patent 6,344,162 (Miyajima) has been obviated by the present amendment.

Namely, independent claim 1 as amended now incorporates the subject matter of original claims 2 and 3, which had not been subject to this anticipation rejection. More particularly, Miyajima does not disclose a die for sealing and molding an electronic component, having a coating layer consisting of a nickel-tungsten alloy containing at least 20% by weight and at most 60% by weight of tungsten. To the contrary, Miyajima discloses only a coating layer consisting of a nickel-**boron**-tungsten alloy, which does not correspond to the present nickel-tungsten alloy, and Miyajima does not disclose anything about the tungsten content of the alloy.

The dependent claims 5 to 8 recite additional features that further distinguish the invention over the prior art. For example, Miyajima does not disclose and would not have suggested providing the coating layer consisting of the presently claimed nickel-tungsten alloy on all of the several defined surfaces including the internal surface of the upper and lower cavities, the internal surface of the resin channel, the internal surface of the concavity, the internal surface of the resin pot, the parting line plane of each die, an external surface of the plunger, an external surface of the ejector pin, an internal

surface of the ejector pin fitting hole, an internal surface of a cull, a runner and a gate, and a surface of an air vent. To the contrary, Miyajima discloses applying a nickel-boron-tungsten alloy only to the parting faces of the dies (col. 16, line 7).

For these reasons, the Examiner is respectfully requested to withdraw the rejection of claims 1 and 5 to 8 as anticipated by Miyajima.

7) Referring to section 4 on page 3 of the Office Action, the rejection of claims 2 to 4 as obvious over Miyajima in view of Japanese reference JP 10-202698 is respectfully traversed.

8) As mentioned above, present amended independent claim 1 now incorporates a further clarification and subject matter from original claims 2 and 3.

Namely, amended claim 1 now recites that the coating layer **consists of** nickel-tungsten alloy, wherein the alloy particularly contains at least 20% by weight and at most 60% by weight of tungsten. This coating layer is provided on a die used for sealing and molding an electronic component with a resin material. Particularly, the coating layer is provided on a surface contacting the melted resin material when the resin material is being molded in the die.

It is significant that there will be a direct contact between the melted resin material and the coating layer consisting of nickel-tungsten alloy. As explained in the present specification, the nickel-tungsten alloy achieves a reduced adhesion with

respect to the resin material, so as to improve the releasing of the resin molded body from the molding die.

These features of the invention would not have been obvious, because the teachings of the two prior art references would not have been combined by a person of ordinary skill in the art, in the manner now proposed by the Examiner.

9) Miyajima discloses a molding machine including a die for sealing and molding an electronic component with a resin material.

To provide good release properties for removing the resin molded body from the die, the main point of the Miyajima disclosure is to provide release films (40, 41) between the surfaces of the molding dies and the resin material (see Abstract; col. 4, lines 50 to 61; col. 5, lines 26 to 42; col. 9, lines 45 to 50; col. 11, lines 42 to 49 and 62 to 67; col. 12, lines 35 to 38; col. 14, lines 6 to 10; and col. 15, lines 22 to 27).

Additionally, in only one paragraph of the disclosure, Miyajima further mentions that the parting faces of the upper and lower dies may be coated with a nickel-boron-tungsten alloy, or a silicic material, fluoric resin, or dispersion coating dispersed with oligomer (col. 16, lines 7 to 15).

As admitted by the Examiner, Miyajima does **not** disclose that such a coating layer shall contain from 20 to 60 wt.% of tungsten. Moreover, Miyajima does **not** disclose that the coating layer consists of a (binary) nickel-tungsten alloy but rather that the coating layer is a (ternary) nickel-**boron**-tungsten alloy.

It is also important to recognize that Miyajima provides a polymer release film between the relevant die surface and the resin material, i.e. the resin molded body. Thus, the provision of a coating of nickel-boron-tungsten alloy appears to be especially pertinent to achieve the easy peeling **of the release film** from the coated die surface (see e.g. Abstract, lines 10 to 14; col. 1, lines 64 to 65; col. 2, lines 8 to 9; col. 4, lines 49 to 61; and col. 15, lines 23 to 27).

From such teachings regarding the use of a nickel-boron-tungsten alloy in combination with a release film, a person of ordinary skill in the art would have found no suggestion or motivation toward using a coating layer consisting of a nickel-tungsten alloy on a surfaces of the die **directly contacting the melted resin material**. In fact, a person of ordinary skill in the art would have found no pertinent suggestions regarding a (binary) nickel-tungsten alloy whatsoever, because Miyajima only discloses or suggests the use of a (ternary) nickel-boron-tungsten alloy.

Miyajima further discloses that the release film must be heat-resistant against the heat generated from the dies (col. 4, lines 54 to 56), and that steps should be taken to protect the release film from the heat of the dies, for example by providing fine projections on the parting faces of the dies, whereby these fine projections **reduce the conduction of heat from the dies** to the release film, such that the release film is heated gradually by the dies (col. 12, lines 55 to 65). In view of these teachings of Miyajima, it would not be desirable to enhance or increase the heat conductivity of the die, but that is exactly the

purpose of the JP 10-202698 reference, as will be discussed below.

10) JP 10-202698 discloses an injection molding die, for example for molding a PVC plastic pipe junction or the like.

The Japanese reference does not directly disclose or relate to, or make any suggestions regarding, **a die for sealing and molding an electronic component with a resin material**. Thus, a person of ordinary skill in the art pertaining to the present invention, upon considering the disclosure of Miyajima, would not have been motivated to directly apply the teachings of JP 10-202698 in combination with those of Miyajima, because of the different contexts and applications of the two references.

More importantly, the two references respectively teach purposes that are directly contrary to each other. Namely, as mentioned above, Miyajima discloses that the release film should be protected from the heat given off by the dies, and particularly that it is **desirable to REDUCE the heat conductivity of the dies** (col. 12, lines 59 to 65). Directly contrary thereto, JP 10-202698 teaches that applying a coating layer of an alloy of nickel and tungsten on an injection molding die part is suitable to **INCREASE the heat conductivity** thereof (see Abstract).

Such a teaching of JP 10-202698, directly contrary to the intended feature of Miyajima, would have motivated a person of ordinary skill in the art directly away from the use of a nickel-tungsten alloy in connection with the resin molding die according to Miyajima. Namely, the JP reference teaches that a coating layer of a nickel-tungsten alloy increases the heat

conductivity of the die, but increasing the heat conductivity of the die would not have been suitable for use in the die arrangement according to Miyajima.

So, even if a ternary nickel-boron-tungsten alloy may have been suitable as a coating layer on the die according to Miyajima, a person of ordinary skill in the art would have expected that a binary nickel-tungsten alloy according to JP 10-202698 would not have been suitable. Accordingly, it would not have been obvious to directly substitute the alloy composition according to JP 10-202698 for the different alloy composition disclosed by Miyajima.

Moreover, neither one of the references would have provided any suggestion or instruction as to whether the alloy composition disclosed by JP 10-202698 would have suitable anti-adhesion properties with respect to the release film or with respect to the molded resin product in the apparatus according to Miyajima (see e.g. col. 4, lines 49 to 56 of Miyajima).

For the above reasons, a person of ordinary skill in the art would not have been motivated to combine the teachings of the two references as proposed by the Examiner, to use the alloy composition according to JP 10-202698 in the arrangement according to Miyajima.

11) For the above reasons, the Examiner is respectfully requested to withdraw the rejection of claims 2 to 4 as obvious over Miyajima in view of JP 10-202698.

12) New dependent claim 9 recites that the nickel-tungsten alloy contains at most 40% by weight of tungsten, as supported by the inventive examples originally disclosed in connection with Table 1 on page 8 and Table 2 on page 9 of the present specification. As can be seen in those test examples, increasing the content of tungsten beyond 40% by weight does not achieve any further benefits with respect to either the required mold release force or the Vickers Hardness of the coating layer. Therefore, it is advantageous not to provide additional "unnecessary" tungsten. This maximum limit of tungsten according to present claim 9 is distinguishable from the alloy composition disclosed by JP 10-202698, which contains from 44 to 60 % tungsten in the example cited by the Examiner.

13) New independent claim 10 is based on the subject matter of original claims 1, 2 and 3, with slightly different claim terminology, format and style, as well as further clarifications. Claim 10 recites that the coating layer forms a surface of the molding die that is directly exposed to and directly contacts the resin for reducing adhesion of the resin on the surface. Claim 10 further recites that the coating layer is an electroplated layer of a binary alloy of nickel and from 20 to 60% by weight of tungsten. These features are distinguishable from the disclosures of the references as discussed above. Claim 11 depending from claim 10 further recites that the alloy contains no more than 40% by weight of tungsten, which is especially distinguishable from the higher tungsten content disclosed by the Japanese reference.

14) Favorable reconsideration and allowance of the application, including all present claims 1 and 4 to 11, are respectfully requested.

Respectfully submitted,

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Encls.:
Marked-Up Version of amended Spec. pages 4, 6, 7, Marked-Up Version of amended claims 1, 5, 7

CERTIFICATE OF FAX TRANSMISSION:

I hereby certify that this correspondence with all indicated enclosures is being transmitted by telefax to (703) 872-9310 on the date indicated below, and is addressed to: Assistant Commissioner for Patents, Washington, D. C. 20231.

Walter F. Fasse 1/31/03

Name: Walter F. Fasse - Date: January 31, 2003

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"Marked-Up Version"

Furthermore, the surface provided with the NiW layer is greater in hardness than a surface processed with HCr. Thus, abrading and damaging the die can be minimized to enhance the durability of the die.

Consequently, the present invention can effectively provide a die used for sealing an electronic component with resin to mold the electronic component that is capable of providing a high-quality product that is highly reliable at a high level of productivity.

The present invention in one embodiment provides the coating layer (A) having a tungsten content of 20% by weight for the following reasons:

If a basic bathing of a nickel-tungsten alloy plating has a tungsten content below 20% by weight, e.g., 10% by weight, it would be a bathing which has a high temperature of 70 to 95°C and is ammonium-alkaline with pH 8 to 9. This high-temperature bathing contains ammonium significantly volatile and it can thus hardly be controlled. The ammonium also smells bad and thus degrades the working environment of interest.

Furthermore, if coating layer (A) has a tungsten content of approximately 10% by weight then electrolysis rapidly increases the layer's electrostatic stress and also decreases the layer's flexibility. This results in a crack in a surface of the coating layer.

Furthermore, while the nickel-tungsten alloy plating as it is has a hardness of approximately Hv. 600, this plating after being heated and thus cured can be as hard as Hv. 1350. In contrast, if a nickel-tungsten alloy plating with a tungsten content of approximately 10% by weight is heated to be cured, and thus it does not cure in separation and can only have a hardness of approximately Hv. 600, i.e. the same hardness of such a exact plating which has not been is no further processed.

Furthermore, a nickel-tungsten alloy plating containing no less than 20% by weight of tungsten is advantageous in that it is not corroded by concentrated hydrochloric acid, sulfuric acid, hydrofluoric acid, or nitric acid.

It should be noted, however, that tungsten is not separated from a solution with its ions existing independently and an induced eutectoid reaction occurs. To allow tungsten to be separated through such an induced eutectoid reaction, tungsten is contained with an upper limit of

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BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a schematic, partially notched vertical cross section of a die used for sealing an electronic component with resin to mold the electronic component in one embodiment of the present invention; and

Fig. 2 is an enlarged, schematic, partially noted vertical cross section of a main portion of the Fig. 1 die.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, one embodiment of the present invention will be described in detail with reference to Figs. 1 and 2.

The present invention in one embodiment provides a die formed of a fixed, top die 1, a movable, bottom die 2 arranged opposite to top die 1, upper and lower cavities 3 and 4 provided in dies 1 and 2 in their respective die planes to face each other along the P. L plane of dies 1 and 2 for molding resin, a concavity 7 receiving and setting a lead frame 6 having an electronic component 5 mounted thereto, a pot 8 arranged in bottom die 2 for supplying a resin material, a plunger 9 fit internal to pot 8 for applying pressure to resin, a resin channel 10 to allow pot 8 and upper cavity 3 to communicate with each other for transporting a melted resin material, heating means 11 and 12 provided for dies 1 and 2, respectively, ejector pins 14 and 15 ejecting and thus releasing from upper and lower cavities 3 and 4 a resin-molded body 13 molded in upper and lower cavities 3 and 4, ejector pin fitting holes 16 and 17 fitting ejector pins 14 and 15, and an air vent 18 allowing upper cavity 8 to communicate external to the die.

Furthermore, resin channel 10 is configured for example of a cull 19 and a runner and gate 20 provided in the top die opposite to pot 8 for dispensing melted resin.

Furthermore, the die has a portion, as required, electroplated through neutral-bathing to have a plating layer A of nickel-tungsten alloy having a thickness as required, as shown in Fig. 2.

Plating layer A of nickel tungsten alloy is provided for example on the upper and lower cavities 3 and 4 internal surfaces, the resin channel 10 (cull 19 and runner and gate 20) internal surface, the air vent 18 surface,

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the concavity 7 surface, the pot 8 internal surface, the die's P. L plane, the plunger 9 external surface, the ejector pins 14 and 15 external surfaces, and the ejector pin fitting holes 16 and 17 internal surfaces.

As such, initially, dies 1 and 2 are heated by heating means 11 and 12 to have a temperature at which resin is molded and also lead frame 6 having electronic component 5 molded thereto is fed to bottom die 2 and set at a predetermined position thereof and a resin material R is supplied into pot 8, and bottom die 2 is moved upward to close dies 1 and 2. Thus, upper and lower cavities 3 and 4 have electronic component 5 and lead frame 6 therearound fit therein.

Then, plunger 9 can apply pressure to the resin material heated and melted in pot 8, to inject the melted resin material into upper and lower cavities 3 and 4 and thus fill the cavities with the melted resin material and also to seal and thus mold electronic component 5 and lead frame 6 therearound in upper and lower cavities 3 and 4 to mold electronic component 5 and lead frame 6 therearound internal to resin-molded body 13 corresponding in geometry to upper and lower cavities 3 and 4.

After the passage of a period of time required for curing the melted resin material, dies 1 and 2 are opened and ejector pins 14 and 15 are used to eject and thus release resin molded body 13 from upper and lower cavities 3 and 4.

There will now be presented a condition for molding a resin and a result of an experiment.

(1) Condition for Molding Resin

i. Die Temperature	180°C
ii. Injection Pressure	9.807 MPa
iii. Injection Rate	21 mm/5 sec
iv. Resin Material	epoxy resin (with no mold release agent added)
v. Die Material	SKD-11
vi. Die Surface Processing	nickel-tungsten alloy plating (NiW), compared with hard chromium plating (HCr)

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MARKED-UP VERSION
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1. (amended) A die used for sealing and molding an electronic component with a resin material, having a coating layer consisting of nickel-tungsten alloy on at least a surface thereof contacting [a melted] the resin material in a melted state when the resin material is molded[.], wherein said coating layer is a plating layer formed of said nickel-tungsten alloy, which contains at least 20% by weight and at most 60% by weight of tungsten.

5. (amended) The die of claim 1, comprising:
a fixed die;
a movable die arranged opposite to the fixed die;
upper and lower cavities provided in said fixed die and said movable die in [their] thereof respective die planes to face each other along a parting-line plane of said fixed die and said movable die, for molding the resin material;
a concavity receiving and setting a support having the electronic component mounted thereto;
a pot arranged at one of said fixed die and said movable die for supplying the resin material;
a plunger fit internal to [the] said pot for applying pressure to the resin material; and
a resin channel to allow said pot and said upper cavity to communicate with each other for transporting the [melted] resin material in the melted state;
wherein said coating layer is provided on an internal surface of said upper and lower cavities, an internal surface of said resin channel, an internal surface of said concavity, an internal surface of said pot, [the] said parting-line plane of each of said fixed die and said movable die, and an external surface of said plunger.

7. (amended) The die of claim 5, wherein said resin channel includes a cull and a runner and gate arranged opposite to said pot for dispensing the [melting] resin material in the melted state, said cull and said runner and gate having an internal surface provided with said coating layer.